2.2 INFORMATION PROCESSING STANDARDS

2.2.1 Introduction

2.2.1.1 Purpose

The purpose of this section is to specify the Joint Technical Architecture (JTA) government and commercial information processing standards the DoD will use to develop integrated, interoperable systems that directly or indirectly support the Warfighter.

2.2.1.2 Scope

This section applies to mission area, support application, and application platform service software. This section does not cover communications standards needed to transfer information between systems (defined in Section 2.3), nor standards relating to information modeling (process, data, and simulation), data elements, or military unique message set formats (defined in Section 2.4).

2.2.1.3 Background

Information Processing (IP) standards provide the data formats and instruction processing specifications required to represent and manipulate data to meet information technology (IT) mission needs. The standards in this section are drawn from widely accepted commercial standards that meet DoD requirements. Where necessary for interoperability, profiles of commercial standards are used. Military standards are mandated only when suitable commercial standards are not available.

2.2.2 Mandates

The following sections provide the applicable mandated standards that shall be used for the selection of commercial or government off-the-shelf (GOTS) software or in the development of government software. Appendix B contains a table that summarizes the mandated standards from this section, as well as providing information on how to obtain the standards.

2.2.2.1 Application Software Entity

The Application Software Entity includes both mission area applications and support applications. Mission area applications implement specific user's requirements and needs (e.g., personnel, material, management). This application software may be commercial off-the-shelf (COTS), GOTS, custom-developed software, or a combination of these.

Common support applications are those (e.g., e-mail and word processing) that can be standardized across individual or multiple mission areas. The services they provide can be used to develop mission-area-specific applications or can be made available to the user. The DoD Technical Reference Model (TRM) defines six support application categories: Multimedia, Communications, Business Processing, Environment Management, Database Utilities, and Engineering Support. The definitions of these categories are found in the TAFIM 3.0, Volume 2, DoD Technical Reference Model, 30 April 1996.

2.2.2.2 Application Platform Entity

The Application Platform Entity is the second layer of the DoD TRM, and includes the common, standard services upon which the required functionality is built. The Application Platform Entity is composed of service areas and cross-area services. The corresponding mandates are provided in the following subsections.

2.2.2.2.1 Service Areas

Seven primary service areas are defined within the Application Platform Entity: Software Engineering, User Interfaces, Data Management, Data Interchange, Graphics, Communications, and Operating System Services.

2.2.2.2.1.1 Software Engineering Services

The software engineering services provide system developers with the tools that are appropriate to the development and maintenance of applications. There are no mandated standards for this service area.

Language services provide the basic syntax and semantic definition for use by developers to describe the desired software function.

"Programming language selections should be made in the context of the system and software engineering factors that influence overall life-cycle costs, risks, and potential for interoperability."[1]

Computer languages should be used in such a way as to minimize changes when compilers, operating systems or hardware change. To maximize portability, the software should be structured where possible so it can be easily ported.

2.2.2.2.1.2 User Interface Services

User Interface Services control how a user interfaces with an information technology system. The Common Desktop Environment (CDE) provides a common set of desktop applications and management capabilities for environments similar to the Microsoft Windows desktop environment. CDE supports Open Software Foundation (OSF) Motif based application execution. Both CDE and Motif applications use the underlying X-Windows system. The Win32 Application Program Interface (API) set provides similar services for Microsoft Windows applications. Applications that require user interaction shall use either Motif/X-Window APIs and be capable of executing in the CDE or the applicable native windowing Win32 APIs. The following standards are mandated:

- C507, Window Management (X11R5): X-Window System Protocol, X/Open CAE Specification, April 1995.
- C508, Window Management (X11R5): Xlib - C Language Binding, X/Open CAE Specification, April 1995.
- C509, Window Management (X11R5): X Toolkit Intrinsics, X/Open CAE Specification, April 1995.
- C510, Window Management (X11R5): File Formats & Application Conventions, X/Open CAE Specification, April 1995.
- C320, Motif Toolkit API, X/Open CAE Specification, April 1995.
- X/Open C323, Common Desktop Environment (CDE) Version 1.0, April 1995.
- Win32 APIs, Window Management and Graphics Device Interface, Volume 1 Microsoft Win32 Programmers Reference Manual, 1993 or later, Microsoft Press.

Refer to Section 2.5 for Human-Computer Interface (HCI) style guidance and standards.

[1] Additional guidance may be found in the memorandum "Use of the Ada Programming Language" by ASD (C3I), April 29, 1997, DoD 5000.2-R, and DoDD 3405.1.

2.2.2.2.1.3 Data Management Services

Central to most systems is the sharing of data between applications. The data management services provide for the independent management of data shared by multiple applications.

These services support the definition, storage, and retrieval of data elements from Database Management Systems (DBMSs). Application code using Relational Database Management System (RDBMS) resources and COTS RDBMSs shall conform to the requirements of Entry Level Structured Query Language (SQL). The following standards are mandated for any system using an RDBMS:

- ISO/IEC 9075: 1992 Information Technology - Database Language - SQL, as modified by FIPS PUB 127-2: 1993, Database Language for Relational DBMSs. (Entry Level SQL).

In addition, the SQL/Call Level Interface (CLI) addendum to the SQL standard provides a standard CLI between database application clients and database servers. The following API is mandated for both database application clients and database servers:

- Open Data-Base Connectivity, ODBC 2.0.

2.2.2.2.1.4 Data Interchange Services

The data interchange services provide specialized support for the exchange of data and information between applications and to and from the external environment. These services include document, graphics data, geospatial data, still imagery data, motion imagery data, multimedia data, product data, atmospheric data, oceanographic data, and time-of-day data.

2.2.2.2.1.4.1 Document Interchange

The Standard Generalized Markup Language (SGML) format supports the production of documents which are intended for long-term storage and electronic dissemination for viewing in multiple formats. SGML formalizes document mark-up, making the document independent of the production and/or publishing system. SGML is an architecture-independent and application-independent language for managing document structures. SGML is a meta-language, providing the rules for designing and applying a system of markup tags rather than the specific set of tags. The following standard is mandated:

- ISO 8879: 1986, Standard Generalized Markup Language (SGML) with Amendment 1, 1998.

The Hypertext Markup Language (HTML) is used for hyper-text formatted and navigational linked documents. For hypertext documents intended to be interchanged via the World Wide Web (WWW) or made available via organizational intra-nets, the following standard is mandated:

- REC-html-971218, Hypertext Markup Language (HTML), Internet Version 4.0, Reference Specification, World Wide Web Consortium (W3C), 18 December 1997 - Interchange format used by the WWW for hypertext format and embedded navigational links.

Table 2.2-1 identifies file formats for the interchange of common document types such as text documents, spreadsheets, and presentation graphics. Some of these formats are controlled by individual vendors, but all of these formats are supported by products from multiple companies. In support of the standards mandated in this section, Table 2.2-1 identifies conventions for file name extensions for documents of various types. The following file formats are mandated, but not the specific products mentioned:

- All applications acquired or developed for the production of documents shall be capable of generating at least one of the formats listed in Table 2.2-1 for the appropriate document type.
- All organizations shall at a minimum be capable of reading and printing all of the formats listed below for the appropriate document type.

Table 2.2-1 Common Document Interchange Formats

Document Type	Standard/Vendor Format	Recommended File Name Extension	Reference
Plain Text	ASCII Text	.txt	ISO/IEC 646:1991 IRV
Compound Document*	Adobe PDF 3.0	.pdf	Vendor
	HTML 4.0	.htm	W3C
	MS Word 6.0	.doc	Vendor
	Rich Text Format	.rtf	Vendor
	WordPerfect 5.2	.wp5	Vendor
Briefing - Graphic Presentation	Freelance Graphics 2.1	.pre	Vendor
	MS PowerPoint 4.0	.ppt	Vendor
Spreadsheet	Lotus 1-2-3 Release 3.x	.wk3	Vendor
	MS Excel 5.0	.xls	Vendor
Database	Dbase 4.0	.dbf	Vendor
Compression	GZIP file format	.gz	RFC 1952
	Zip file format	.zip	Vendor

Notes: * - Compound documents contain embedded graphics, tables, and formatted text. OLE linking complicates document interchange. IRV is International Reference Version. Note that some special fonts, formatting, or features supported in the native file format may not convert accurately.

2.2.2.2.1.4.2 Graphics Data Interchange

These services are supported by device-independent descriptions of the picture elements for vector and raster graphics. The ISO Joint Photographic Expert Group (JPEG) standard describes several alternative algorithms for the representation and compression of raster images, particularly for photographs. The standard does not specify an interchange format for JPEG images, which led to the development of the JPEG File Interchange Format (JFIF) format. Graphics Interchange Format (GIF) and JFIF are de facto standards for exchanging graphics and images over the internet. GIF supports lossless compressed images with up to 256 colors and short animation segments. GIF is mandated for use on an internet when such a format is needed. Note that Unisys owns a related patent, which requires a license for software that writes the GIF format. Readers of the GIF format have no royalty obligations. JFIF supports compressed images and is mandated for the interchange of lossy compressed, non-georeferenced photographic images over an internet (under Graphics Data Interchange). The following standards are mandated:

- ANSI/ISO/IEC 8632.1-4:1992 (R1997); ISO 8632:1992 with Amendment 1:1994 and Amendment 2:1995 as profiled by FIPS PUB 128-2: 17 April 1996, Computer Graphics Metafile (CGM)-Interchange format for vector graphics data.
- JPEG File Interchange Format (JFIF), Version 1.02, C-Cube Microsystems for raster graphics data encoded using the ISO/IEC 10918-1:1994, Joint Photographic Experts Group (JPEG) algorithm.
- Graphics Interchange Format (GIF), Version 89a, 31 July 1990, CompuServe Incorporated.

2.2.2.2.1.4.3 Geospatial Data Interchange

Geospatial services are also referred to as mapping, charting, and geodesy (MC&G) services. Raster Product Format (RPF) defines a common format for the interchange of raster-formatted digital geospatial data among DoD Components. Existing geospatial products which implement RPF include Compressed Arc Digitized Raster Graphics (CADRG), Controlled Image Base (CIB), and Digital Point Positioning Data Base (DPPDB). For raster-based products, the following standard is mandated:

- MIL-STD-2411A, Raster Product Format, 6 October 1994; with Notice of Change, Notice 1, 17 January 1995.

Vector Product Format (VPF) defines a common format, structure, and organization for data objects in large geographic databases that are based on a georelational data model and intended for direct use. Existing geospatial products which implement VPF include Vector Map (VMap) Levels 0-2, Urban Vector Map (UVMap), Digital Nautical Chart (DNC), Vector Product Interim Terrain Data (VITD), Digital Topographic Data (DTOP), and World Vector Shoreline Plus (WVS+). For vector-based products, the following standard is mandated:

- MIL-STD-2407, Interface Standard for Vector Product Format (VPF), 28 June 1996.

WGS 84, a Conventional Terrestrial Reference System (CTRS), is mandated for representation of a reference frame, reference ellipsoid, fundamental constants, and an Earth Gravitational Model with related geoid. Included in the Reference System are parameters for transferring to/from other geodetic datums. WGS 84 will be used for all joint operations and is recommended for use in multinational and unilateral operations after coordination with allied commands (CJCS). The following standard is mandated:

- MIL-STD-2401, Department of Defense World Geodetic System (WGS 84), 11 January 1994.

FIPS PUB 10-4 provides a list of the basic geopolitical entities in the world, together with the principal administrative divisions that comprise each entity. For applications involving the interchange of geospatial information requiring the use of country codes, the following standard is mandated:

- FIPS PUB 10-4, Countries, Dependencies, Areas of Special Sovereignty, and Their Principal Administrative Divisions, April 1995.

Additional information on other Geospatial services not identified in the mandated standards is available in NIMAL 805-IA, NIMA GGI&S List of Products and Services, January 1997.

2.2.2.2.1.4.4 Still Imagery Data Interchange

The National Imagery Transmission Format Standard (NITFS) is a DoD and Federal Intelligence Community suite of standards for the exchange, storage, and transmission of digital imagery products and image related products. NITFS provides a package containing information about the image, the image itself, and optional overlay graphics. The Standard provides a ‘package’ containing an image(s), subimages, symbols, labels, and text as well as other information related to the image(s). NITF supports the dissemination of secondary digital imagery from overhead collection platforms. Guidance on applying the suite of standards composing NITFS can be found in MIL-HDBK-1300A. The following standards are mandated for imagery product dissemination:

- MIL-STD-2500A, National Imagery Transmission Format (Version 2.0) for the National Imagery Transmission Format Standard, 12 October 1994, Revised 7 February 1997.
- MIL-STD-188-196, Bi-Level Image Compression for the National Imagery Transmission Format Standard, 18 June 1993.
- MIL-STD-188-199, Vector Quantization Decompression for the National Imagery Transmission Format Standard, 27 June 1994.
- MIL-STD-2301A, Computer Graphics Metafile (CGM) Implementation Standard for the National Imagery Transmission Format Standard, 18 June 1993, with Notice of Change 1, 12 October 1994, profiled by ANSI/ISO 8632:1992 Computer Graphics Metafile (CGM) for the Storage and Transfer of Picture Description Information.
- ISO/IEC 10918-1: 1994, Joint Photographic Experts Group (JPEG) as profiled by MIL-STD-188-198A, Joint Photographic Experts Group (JPEG) Image Compression for the National Imagery Transmission Format Standard, 15 December 1993. Although the NITFS uses the same ISO JPEG algorithm as mandated in Section 2.2.2.2.1.4.2, the NITFS file format is not interchangeable with the JFIF file format.

Communication protocols for transmission of imagery over point-to-point tactical data links in high Bit Error Rate (BER), disadvantaged communications environments are specified in Section 2.3.2.1.4.

2.2.2.2.1.4.5 Motion Imagery Data Interchange

Motion Imagery is sequential or continuous streaming images at specified temporal rates (normally expressed as frames per second) at frame rates of 1 Hz (1 frame per second) or higher.

2.2.2.2.1.4.5.1 Video Systems

Video systems, defined as electro-optical motion imagery whose formats are governed by national and international standards, are divided into four categories:

1. Video Imagery Systems create, transmit, edit, store, archive or disseminate digital video for real-time, near-real time or for other end-user product distribution, usually in support of Intelligence, Reconnaissance, and Surveillance (ISR) activities.
2. Video Teleconference Systems provide real-time visual interchange between remote locations typically in support of meetings. When video teleconference systems are used for the display of Video Imagery, the standards in the Video Imagery section apply.
3. Video Telemedicine Systems provide real-time visual interchange between remote locations in biomedical applications including fiber optic and video teleconferencing.
4. Video Support Systems enable end-user applications associated with video based training; news gathering or other non-critical functions that do not directly support the warfighter. This includes traditional studio and field video productions which are not associated with DoD warfighter operations.

The standards and use directives for each class of video system are noted in the following sections:

2.2.2.2.1.4.5.1.1 Video Imagery

The "DoD/IC/USIGS Video Imagery Standards Profile (VISP)," Version 1.21, 7 January 1998, describes the minimum set of standards and guidelines for the acquisition of systems that produce, use, or exchange Video Imagery information. The United States Imagery and Geospatial Information System (USIGS) is the federation of organizations within U.S. government that collectively or individually acquire, produce, or deliver imagery, imagery intelligence, and geospatial information and services. The VISP identifies commercial standards that support interoperability for USIGS environments. Digital video standards (as defined in the VISP) are for use in all new or upgraded DoD systems. Legacy video imagery systems that currently use analog formats may continue to use their existing analog components. The following standards, as profiled in VISP 1.21, 7 January 1998, are mandated for video imagery:

- ITU-R BT.601-4, Encoding Parameters of Digital Television for Studios, Component (4:2:2) Digital Video, 1994, shall be used for baseband (uncompressed) video signal waveforms.
- ANSI/SMPTE 259M-1993, Television - 10 bit 4:2:2 Component (Serial Digital Interface), 1993, using ITU-R BT.601-4 Component (4:2:2) digital video waveforms, shall be the uncompressed baseband signal transport and processing standard for digital video, audio and metadata origination, system interface, production/analysis center processing and manipulation.
- ISO/IEC 13818 - 1,2,4 "MPEG-2, 4:2:2 Profile @ Main Level" (4:2:2 P @ ML), 1996 shall be the compression profile for initial link origination, transmission, production, manipulation, and computer based archiving (disk based) where further image processing is anticipated.
- ISO/IEC 13818 – 1,2,4 "MPEG-2, 4:2:0 Main Profile @ Main Level" (MP @ ML), 1996 shall be the minimum quality compression profile for end-user video product distribution, including wide area transmissions, where limited additional image processing is anticipated and where bandwidth limitations preclude use of 4:2:2 P @ ML.
- ANSI/SMPTE 12M-1995, Television, Audio and Film - Time and Control Code, commonly known as Society and Motion Picture and Television Engineers (SMPTE) time code, shall be the standard for time annotation and embedded time references for video systems. Furthermore, within 12M, Vertical Interval Time Code (VITC), Drop Frame shall be used for 29.97 FPS systems, Non-Drop Frame Time Code shall be used for 24, 25, 30, 50, and 60 FPS systems. Note: Analog NTSC systems are based on 29.97 FPS.

The standards for Video Imagery section does not completely define an architecture for interoperability for low bandwidth (below 1.5 Mbits/s) real-time streaming applications. Standards for such low bandwidth applications are actively under development. Until such standards are available, users may use "MPEG-1" or "MPEG-2 4:2:0 MP@ML Adaptive Field Frame" standards for low bandwidth video applications. DoD users that adopt proprietary video compression systems for very low bandwidth applications are cautioned that such systems are generally not supported within DoD and that the interoperability of such systems is not assured.

2.2.2.2.1.4.5.1.2 Video Teleconference

Video Teleconferencing (VTC) standards are specified in Section 2.3.2.1.2.

2.2.2.2.1.4.5.1.3 Video Telemedicine

Video Telemedicine System interchange standards will be addressed in a later version of the JTA.

2.2.2.2.1.4.5.1.4 Video Support

MPEG-1 is an open international standard for video compression that has been optimized for single and double-speed CD-ROM data transfer rates. The standard defines a bit-stream representation for synchronized digital video and audio, compressed to fit into a bandwidth of 1.5 Mbits/s. This corresponds to the data retrieval speed from CD-ROM and Digital Audio Tape (DAT). With 30 frames per second video at a display resolution of 352 x 240 pixels, the quality of compressed and decompressed video at this data rate is often described as similar to a VHS recording. A major application of MPEG is the storage of audiovisual information on CD-ROM and DAT. MPEG is also gaining ground on the Internet as an interchange standard for video clips because the shell format is interoperable across platforms and considered to be platform-independent. The following standards are mandated:

- ISO/IEC 11172-1: 1993 Coding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbits/s – Part 1: Systems, 1993.
- ISO/IEC 11172-1: 1993/Cor. 1:1995 Coding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbits/s – Part 1: Systems Technical Corrigendum 1; 1993/1995.
- ISO/IEC 11172-2: 1993 Coding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbits/s – Part 2 Video; 1993.

MPEG-2 Main Profile @ Main Level (MP@ML) 4:2:0 systems are fully backward compatible with the MPEG-1 standard. MPEG-2 MP@ML can be used with all video support systems (storage, broadcast, network) at bit rates from 3 to 10 Mbits/s, where limited additional processing is anticipated, operating in either progressive or interlaced scan mode, optimally handling the resolution of the ITU-R 601 recommendation (that is, 720 x 480 pixels for the luminance signal and 360 x 480 pixels for the color space). The following video support standards for compressed video are mandated:

- ISO/IEC 13818-1: 1996 - Generic Coding of Moving Pictures and Associated Audio Information - Part 1: Systems (MPEG-2); 1996, with Amendment 1:1997. (The identical text is also published as ITU-T Rec. H.222.0.).
- ISO/IEC 13818-2: 1996 - Generic Coding of Moving Pictures and Associated Audio Information - Part 2: Video (MPEG-2); 1996, with Amendment 1:1997 and Amendment 2:1997. (The identical text is also published as ITU-T Rec. H.262).

The following video support applications will be addressed in a later version of the JTA:

- Moving Target Indication (MTI)
- Synthetic Aperature Radar (SAR)
- Infrared (IR)

2.2.2.2.1.4.6 Audio Data Interchange

Effective compression of audio data depends not only upon data compression techniques but also upon the application of a psycho-acoustic model that predicts which sounds humans are likely to be able to hear or not hear in given situations. The sounds selected for elimination depend on the bit rate available for streaming the audio data when the file is decoded and played. Therefore, the best selection of a file format depends upon the bandwidth assumed to be available on the platform that will decode the file. For audio files intended to be decoded in an environment with a target bit rate of about 56 to 64 kilobits per second (Kbits/s) per audio channel, the following format is mandated.

- ISO/IEC 11172-3: 1993, Encoding of moving pictures and associated audio for digital storage media at up to about 1.5 Megabits per second (Mbits/s) – Part 3 (Audio Layer-3 only).
- ISO/IEC 11172-3/Cor. 1: 1996, Encoding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbits/s – Part 3: Audio Technical Corrigendum (Audio Layer-3 only).
- ISO/IEC 11172-1: 1993 Coding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbits/s – Part 1: Systems, 1993.
- ISO/IEC 11172-1: 1993/Cor. 1:1995 Coding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbits/s – Part 1: Systems Technical Corrigendum 1, 1993/1995.

2.2.2.2.1.4.6.1 Audio Associated with Video

The classes of audio in support of video have been subdivided into four categories:

1. Audio for Video Imagery Systems create, transmit, edit, store, archive or disseminate audio for real-time, near-real time and other end-user product distribution, usually in support of Intelligence, Reconnaissance, and Surveillance (ISR) activities.
2. Audio for Video Teleconference Systems provide real-time verbal interchange between remote locations, typically in support of meetings. When video teleconference systems are used for the display of Video Imagery, the standards in the Audio for Video Imagery section apply.
3. Audio for Video Telemedicine Systems provide real-time visual interchange between remote locations in support of biomedical applications including fiber optic and video teleconferencing.
4. Audio for Video Support Systems enable end-user applications associated with video/audio based training; news gathering; or other non-critical functions that do not directly support the warfighter. This includes traditional studio and field productions which are not associated with DoD warfighting operations.

The standards and use directives for each category of audio application are given in the following sections.

2.2.2.2.1.4.6.1.1 Audio for Video Imagery

For audio systems associated with Video Imagery applications, the audio sub-sections of the "USIGS Video Imagery Standards Profile (VISP)," Version 1.21, 7 January 1998 apply. The following standards are mandated:

- ANSI S4.40-1992/AES3-1992, AES (Audio Engineering Society) Recommended Practice for Digital Audio Engineering - Serial transmission format for two-channel linearly represented digital audio data, 1992 (reaffirmed and amended 1997). Used for digital audio signal interchange in uncompressed digital video.
- ISO/IEC 13818-3:1995, Information technology - Generic coding of moving pictures and associated audio information, with Amendment 1:1996. Used for compressed digital audio systems, MPEG-2 Part 3: Audio.

2.2.2.2.1.4.6.1.2 Audio for Video Teleconference

Video Teleconferencing (VTC) standards are specified in Section 2.3.2.1.2.

2.2.2.2.1.4.6.1.3 Audio for Video Telemedicine

Audio for Video Telemedicine system interchange standards will be addressed in a later version of the JTA.

2.2.2.2.1.4.6.1.4 Audio for Video Support

Effective compression of audio data depends not only upon data compression techniques but also upon the application of a psycho-acoustic model that predicts which sounds humans are likely to be able to hear or not hear in given situations. The sounds selected for elimination depend on the bit rate available for streaming the audio data when the file is decoded and played. Therefore, the best selection of a file format depends upon the bandwidth assumed to be available on the platform that will decode the file. For audio files intended to be decoded in an environment with a target bit rate of about 56 to 64 kilobits per second (Kbits/s) per audio channel, the following format is mandated:

- ISO/IEC 11172-3: 1993, Encoding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbits/s - Part 3 (Audio Layer-3 only).
- ISO/IEC 11172-3/Cor. 1: 1996, Encoding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbits/s - Part 3: Audio Technical Corrigendum (Audio Layer-3 only).

2.2.2.2.1.4.6.2 Audio Not Associated with Video Systems

Formats for the exchange of stand-alone audio will be addressed in a later version of the JTA.

2.2.2.2.1.4.7 Multimedia Data Interchange

Formats for the exchange of multimedia data will be addressed in a later version of the JTA.

2.2.2.2.1.4.8 Product Data Interchange

Formats for the exchange of product data are not addressed in the main body of the JTA.

2.2.2.2.1.4.9 Atmospheric Data Interchange

The following formats are established by the World Meteorological Organization (WMO) Commission for Basic Systems (CBS) for meteorological data. The WMO Format for the Storage of Weather Product Information and the Exchange of Weather Product Messages in Gridded Binary (GRIB) Form. GRIB was developed for the transfer of gridded data fields, including spectral model coefficients, and of satellite images. A GRIB record (message) contains values at grid points of an array, or a set of spectral coefficients, for a parameter at a single level or layer as a continuous bit stream. It is an efficient vehicle for transmitting large volumes of gridded data to automated centers over high speed telecommunication lines using modern protocols. It can serve as a data storage format. While GRIB can use predefined grids, provisions have been made for a grid to be defined within the message. The following standard is mandated:

- FM 92-X Ext. GRIB WMO No. 306, Manual on Codes, International Codes, Volume I.2 (Annex II to WMO Technical Regulations) Parts B and C.

The WMO Binary Universal Format for Representation (BUFR) is used for interchange of meteorological data. Besides being used for the transfer of data, BUFR is used as an on-line storage format and as a data archiving format. A BUFR record (message) containing observational data of any sort also contains a complete description of what those data are: the description includes identifying the parameter in question, (height, temperature, pressure, latitude, date, and time), the units, any decimal scaling that may have been employed to change the precision from that of the original units, data compression that may have been applied for efficiency, and the number of binary bits used to contain the numeric value of the observation. BUFR is a purely binary or bit oriented form. The following standard is mandated:

- FM 94-X Ext. BUFR WMO No. 306, Manual on Codes, International Codes, Volume I.2 (Annex II to WMO Technical Regulations) Parts B and C.

2.2.2.2.1.4.10 Oceanographic Data Interchange

Standard transfer formats are required for the pre-distribution of oceanographic information. WMO GRIB and the BUFR file transfer formats are used for this purpose. The GRIB and BUFR formats include several extensions, including provision for additional variables, additional originating models, a standard method to encode tables and line data; a method to encode grids (tables) with an array of data at each grid point (table entry); and a method to encode multiple levels in one GRIB message. There is also a possible need to incorporate a method for vector product data. The following WMO CBS format for oceanographic data is mandated:

- FM 94-X Ext. BUFR WMO No. 306, Manual on Codes, International Codes, Volume I.2 (Annex II to WMO Technical Regulations) Parts B and C.

2.2.2.2.1.4.11 Time of Day Data Interchange

Coordinated Universal Time (UTC), traceable to UTC(USNO) maintained by the U.S. Naval Observatory (USNO), shall be used for time of day information exchanged among DoD systems. Time of day information is exchanged for numerous purposes including time stamping events, determining ordering, and synchronizing clocks. Traceability to UTC(USNO) may be achieved by various means depending on system-specific accuracy requirements. These means may range from a direct reference via a GPS time code receiver to a manual interface involving an operator, wristwatch, and telephone based time service. The UTC definition contained in the following standard, traceable to UTC(USNO), is mandated:

- ITU-R Recommendation TF.460-4, Standard-frequency and Time-signal Emissions, International Telecommunications Union, July 1986.

Note that the Global Positioning System (GPS) provides time of day information that is traceable to UTC(USNO). Also, note that leap seconds are inserted or deleted when necessary in UTC to keep the time of day system synchronized with the Earth's rotation.

2.2.2.2.1.5 Graphic Services

These services support the creation and manipulation of graphics. The following standards are mandated for non-COTS graphics development:

- ANSI/ISO/IEC 9636-1,2,3,4,5,6:1991 (R1997), Information Technology Computer Graphics Interfacing (CGI) Techniques for Dialogue with Graphics Devices.
- The OpenGL Graphics System: A Specification (Version 1.1) 25 June 1996 (for three-dimensional graphics).

2.2.2.2.1.6 Communications Services

These services support the distributed applications that require data access and applications interoperability in networked environments. The mandated standards are provided in Section 2.3.

2.2.2.2.1.7 Operating System Services

These core services are necessary to operate and administer a computer platform and to support the operation of application software. They include kernel operations, shell, and utilities. The kernel controls access to information and the underlying hardware. These services shall be accessed by applications through either the standard Portable Operating System Interface (POSIX) or WIN32 APIs. Not all operating system services are required to be implemented, but those that are used shall comply with the standards listed below.

The following standards are mandated:

Note: References to "C language" are part of the formal titles of some standards in this section, denoting the language used to define the standard.

- ISO/IEC 9945-1:1996, Information Technology – Portable Operating System Interface (POSIX) – Part 1: System Application Program Interface (API)[C language] (Mandated Services).

- ISO/IEC 9945-1:1996:(Real-time Extensions) to ISO/IEC 9945-1:1996, Information Technology - Portable Operating System Interface (POSIX) – Part 1: System Application Program Interface (API) [C language] (Real-time Optional Services).
- ISO/IEC 9945-1:1996:(Thread Extensions) to ISO/IEC 9945-1:1996, Information Technology - Portable Operating System Interface (POSIX) – Part 1: System Application Program Interface (API) [C language] (Thread Optional Services).
- ISO/IEC 9945-2: 1993, Information Technology - Portable Operating System Interface (POSIX) - Part 2: Shell and Utilities, as profiled by FIPS PUB 189: 1994, Information Technology - Portable Operating System Interface (POSIX) – Recommendations (Section 12) and Implementation Guidance (Section 13).
- IEEE 1003.2d: 1994, POSIX – Part 2: Shell and Utilities – Amendment: Batch Environment.
- IEEE 1003.5: 1992, IEEE Standard for Information Technology – POSIX Ada Language Interfaces – Part 1: Binding for System Application Program Interface (API) with Interpretations, March 1994.
- IEEE 1003.5b: 1996, IEEE Standard for Information Technology – POSIX Ada Language Interfaces – Part 1: Binding for System Application Program Interface (API) – Amendment 1: Real-time Extensions. (Incorporates IEEE 1003.5:1992).
- Win32 APIs, Window Management and Graphics Device Interface, Volume 1 Microsoft Win32 Programmers Reference Manual, 1993 or later, Microsoft Press.

2.2.2.2.2 Application Platform Cross-Area Services

The DoD TRM defines four application platform cross-area services: Internationalization, Security, System Management, and Distributed Computing Services.

2.2.2.2.2.1 Internationalization Services

The internationalization services provide a set of services and interfaces that allow a user to define, select, and change between different culturally related application environments supported by the particular implementation. These services include character sets, data representation, cultural convention, and native language support.

In order to interchange text information between systems, it is fundamental that systems agree on the character representation of textual data. The following character set coding standards, which build upon the ASCII character set, are mandated for the interchange of 8-bit and 16-bit textual information respectively:

- ANSI/ISO 8859-1:1987, Information Processing – 8-Bit Single Byte Coded Character Sets, Part 1: Latin Alphabet No. 1.
- ISO/IEC 10646-1:1993, Information Technology - Universal Multiple-Octet Coded Character Set (UCS) – Part 1: Architecture and Basic Multilingual Plane with Technical Corrigendum 1:1996.

2.2.2.2.2.2 Security Services

These services assist in protecting information and computer platform resources. They must often be combined with security procedures, which are beyond the scope of the information technology service areas, to fully meet security requirements. Security services include security policy, accountability, and assurance. (Note: Security Service standards have been consolidated in Section 2.6.)

2.2.2.2.2.3 System Management Services

These services provide capabilities to manage an operating platform and its resources and users. System management services include configuration management, fault management, and performance management. Network Management mandated standards are provided in Section 2.3.2.4. There are no standards currently mandated for systems management. Emerging Network Management Standards can be found in Section 2.3.3.5.

2.2.2.2.2.4 Distributed Computing Services

These services allow various tasks, operations, and information transfers to occur on multiple, physically- or logically-dispersed, computer platforms. These services include, but are not limited to: global time; data, file, and name services; thread services; and remote process services. There are two categories of Distributed Computing Services: Remote Procedure Computing and Distributed Object Computing.

2.2.2.2.2.4.1 Remote Procedure Computing

The mandated standards for remote procedure computing are identified in the Open Group Distributed Computing Environment (DCE) Version 1.1. The mandated standards are:

- C310, DCE 1.1: Time Services Specification, X/Open CAE Specification, November 1994.
- C311, DCE 1.1: Authentication and Security Services, Open Group CAE Specification, August 1997.
- C705, DCE 1.1: Directory Services, Open Group CAE Specification, August 1997.
- C706, DCE 1.1: Remote Procedure Call, Open Group CAE Specification, August 1997.

The C311 specification is included here to provide the complete definition of the DCE. Section 2.6, Information Systems Security Standards, specifies the other security requirements that must be met.

When used in conjunction with the POSIX Threads Extensions, the recommendations of the Open Group's Single UNIX Specification 1998 (UNIX 1998) is expected to integrate the DCE thread model with the POSIX thread model.

2.2.2.2.2.4.2 Distributed Object Computing

The mandate for distributed object computing is interworking with the Object Management Group (OMG) Object Management Architecture (OMA), composed of the Common Object Request Broker Architecture (CORBA), CORBAservices, and CORBAfacilities. The CORBA specification defines the interfaces and services for Object Request Brokers, including an Interface Definition Language (IDL) and the Internet Inter-ORB Protocol (IIOP). CORBAservices define interfaces and semantics for services required to support distributed objects, such as naming, security, transactions, and events. CORBAfacilities defines interfaces and semantics for services required to support functions such as compound document manipulation. Interworking is the exchange of meaningful information between computing elements (semantic integration). Application Level Interworking, for CORBA, results in CORBA clients interacting with non-CORBA servers and non-CORBA clients interacting with CORBA servers. For OLE/COM, Application Level Interworking results in COM/OLE clients interacting with non-COM/OLE servers and non-COM/OLE clients interacting with COM/OLE servers.

The CORBA interoperability mandate does not preclude the use of other distributed object technologies, such as ActiveX/DCOM or Java, as long as the capability for interworking with CORBA applications and objects is maintained by the non-CORBA system. Products are available that allow interworking among distributed object techniques. Interworking with the following specification is mandated:

- The Common Object Request Broker: Architecture and Specification, Version 2.1, OMG document formal/1 September 1997.

When a CORBA Object Request Broker (ORB) is used, the following specifications are mandated:

- Naming Service, 7 December 1993, contained in CORBAservices: Common Object Services Specification, OMG Document formal/4 July 1997.
- Event Notification Service, 7 December 1993, contained in CORBAservices: Common Object Services Specification, OMG Document formal/24 February 1997.
- Object Transaction Service, 6 December 1994, contained in CORBAservices: Common Object Services Specification, OMG Document formal/24 February 1997.

2.2.3 Emerging Standards

The standards listed in this subsection are expected to be elevated to mandatory status when implementations of the standards mature.

2.2.3.1 User Interface

The Open Group released version 2.1 of the Common Desktop Environment (CDE) which integrates the Motif 2.1 graphical user interface, X Window System (X11R6), and CDE to standardize application presentations in distributed multi-platform environments. This framework provides not only mechanisms for graphical display of common objects, but also standard interprocess communication mechanisms and a set of commonly-used desktop tools (e.g., file manager and mail tool) that are relevant to many domains.

2.2.3.2 Data Management

Within Data Management Services, standards for both RDBMS and Object-Oriented Database Management Systems (OODBMSs) will continue to evolve and mature. In the RDBMS domain, SQL3 is being developed by the ANSI X3H2 committee. In the OODBMS domain, the Object Database Management Group (ODMG) is evolving from the ODMG-93 specification to the ODMG-9x standard. SQL3 and ODMG-9x are being developed in parallel to ensure as much commonality as possible.

2.2.3.3 Data Interchange

2.2.3.3.1 Document Interchange

The eXtensible Markup Language (XML), REC-xml-19980210, Extensible Markup Language, W3C Recommendation, 10 February 1998, is being defined by the World Wide Web Consortium (W3C) and is a metalanguage, based on SGML, for describing languages based on name-attribute tuples. XML allows domain specific markup languages and customized, application-specific markup languages to be defined through the use of application profiles using application-specific tagged data items. The resulting XML documents are conforming SGML documents that, while primarily intended for use in the exchange of metadata, support the embedding of URLs and style sheets. This allows XML tags to be used to represent concepts at multiple levels of abstraction, facilitate metadata searches, provide direct access to data described by the metadata, and provide information as to how to obtain data that is not available directly on-line. Finally, XML allows new capabilities to be defined and delivered dynamically.

2.2.3.3.2 Graphics Data Interchange

The Portable Network Graphics (PNG) format (IETF RFC-2083 PNG Specification Version 1.0, 16 January 1997) has been developed as a patent-free replacement for GIF. PNG is an extensible file format for the lossless, portable, well-compressed storage of raster images. Indexed-color, grayscale, and truecolor images are supported, plus an optional alpha channel for transparency. The Internet Media Type image/png was approved on 14 October 1996. The PNG specification was issued as a W3C Recommendation on 1 October 1996. Product support for PNG is growing, but is not yet sufficient to justify mandating the use of the format.

2.2.3.3.3 Virtual Reality Modeling Language

The Virtual Reality Modeling Language (VRML) is developing into a commercial standard with capabilities for 3-D representation of data.

2.2.3.3.4 Geospatial Data Interchange

DIGEST (Digital Geographic Information Exchange Standard) 2.0, June 1997, has been developed by the DGI Working Group (DGIWG) to support the transfer of DGI between GISs in DoD, U.S., NATO, and co-producer countries. The DIGEST is evolving to supersede many of the MIL-STDs, such as MIL-STD-2411, Vector Product Format, that are currently maintained by the DoD.

Some Geospatial MIL-STDs are being reclassified as Interface Standards. Draft MIL-STD-2405, Datums, Coordinates, and Grids is being revised as an Interface Standard.

The NIMA Technical Report for the DoD World Geodetic System (WGS-84) 1984, NIMA TR8350.2, Third Edition, 4 July 1997, has been updated and approved. The report has been submitted for joint review and the development of an implementation plan. TR8350.2 is the technical implementation of MIL-STD-2401, DoD World Geodetic System (WGS84).

2.2.3.3.5 Still Imagery Data Interchange

MIL-STD-2500B, National Imagery Transmission Format (Version 2.1) for the National Imagery Transmission Format Standard has been approved, with an effective date of 1 October 1998. The NITFS is proposed for adoption as ISO standard (ISO 12087-5 BIIF).

Several NITFS (National Imagery Transmission Format Standard) Support Data Extensions (SDEs) have been developed to extend the functionality of the standard file format for imagery and imagery-related products. These SDEs provide support for using the NITFS with SAR, commercial satellite imagery and georeferenced imagery.

2.2.3.3.6 Motion Imagery Data Interchange

2.2.3.3.6.1 Video Systems

2.2.3.3.6.1.1 Video Imagery

The DoD/IC/USIGS Video Imagery Standards Profile (VISP), Version 1.21, 7 January 1998, Chapter 3 outlines emerging Standards, Profiles, and Recommended Practices for Video Imagery applications. VISP Chapter 3 emerging video imagery standards include profiles for High Definition Television Systems (HDTV); Advanced Television Systems (ATV); Video Metadata Systems, to include Intelligence Video Index, Content Description Metadata; Advanced Video Index; Ancillary Data; Advanced Video Index Encoding; Ancillary Data, Encoding into MPEG-2 Private Data Streams; Ancillary Data, Encoding into AES3 Data Streams; Time Code Embedding; Time Reference Synchronization; and completion of all levels of the Video Systems (Spatial and Temporal) Matrix (VSM).

It is also anticipated that MPEG-4 and MPEG-7 may be used for very low data rate video dissemination applications (such as VSM 1 and VSM 2).

ATSC A/52 (Audio), Dolby Digital AC3 is an emerging standard for advanced television applications.

2.2.3.3.6.1.2 Video Teleconference

Emerging standards for video teleconferencing are covered in the Information Transfer section of the JTA, Section 2.3.3.1.2.

2.2.3.3.7 Multimedia Data Interchange

The Draft “DoD Guide to Selecting Computer-Based Multimedia Standards, Technologies, Products, and Practices”, dated 15 February 1998, defines emerging standards for DoD systems employing Multimedia. In this context, interactivity is a key distinguishing characteristic, where “two or more media types (audio, video, imagery, text, and data) are electronically manipulated, integrated, and reconstructed in synchrony, where interactivity indicates an ability of a user to make decisions or selections which (can) alter the type and sequence of information or communication.”

2.2.3.4 Operating Systems

2.2.3.4.1 POSIX

The following POSIX standards are emerging:

- P1003.1d Real-Time System API Extensions.
- P1003.1g Protocol Independent Interfaces.
- P1003.1h Services for Reliable, Available, Serviceable Systems.
- P1003.1j Advanced Real-time System API Extensions.
- P1003.1m Checkpoint Restart.
- P1003.1q System API: The Trace Amendment.
- P1003.13 Standardized Application Environment Profile - POSIX Real-time Application Support.
- P1003.21 Real-Time Distributed Systems Communication.

2.2.3.4.2 UNIX

The X/Open Single UNIX Specification (SUS) Version 2 (T912) (previously referred to as Specification 1170, February 1997) has been updated to include POSIX real-time interfaces. Operating systems that conform to this specification and have received the UNIX brand from X/Open are on the market. For UNIX-based implementations, strong emphasis should be placed on acquiring systems that are SUS conformant over those that are not.

2.2.3.4.3 Virtual Machines

The Java Virtual Machine (JVM) and supporting libraries are an emerging standard. The JVM may be used to support applications executed through a web browser or to support development of portable applications. The Java Virtual Machine is defined in "The Java Virtual Machine Specification" by Tim Lindholm and Frank Yellin, Addison-Wesley, 1997. An overview of Java libraries and their status is available on the World Wide Web at:

http://java.sun.com/products/api-overview/index.html

2.2.3.5 Distributed Computing

- OSF-DCE Version 1.2.2 was issued to developers by the Open Group in November 1997.

Among the many emerging standards from the Object Management Group, there are three newly adopted specifications and one soon-to-be-adopted specification that bear particular consideration: the Unified Modeling Language (UML), the Meta-Object Facility (MOF), the COM/CORBA interworking specification, and the Mobile Agent Facility specification. In addition, there are a wide variety of specifications in various stages of development, including, but not limited to: real-time CORBA; a CORBA Scripting Language; a Messaging Service; a Negotiation Service and Electronic Payment Service for electronic commerce applications; a Healthcare Claims Facility; and much more.